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Standard Formula Calibration

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on behalf of the CAS RBC Dependencies and Calibration Working Party

Introduction


- Dependencies and Calibration Working Party (DCWP) of the CAS
 - Researching methods for calibrating P&C RBC parameters
 - Particularly underwriting and reinsurance risks
 - Many workstreams, many contributors (see appendix)
- Caveats
 - The analysis is solely the responsibility of the work stream participants, DCWP members and not that of their employers, the CAS or the American Academy of Actuaries
 - Presentation assumes the audience has a working knowledge of Standard Formulas
 - Some slides describe preliminary work, which may change materially as research progresses
- Results published in CAS E-Forum when finalized



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Key Findings

1. Size (LOB-size) matters	Not surprising... but it's not just "law of large numbers"
2. Type of company matters	Especially significant for specialty lines
3. Diversification metrics	Little difference between simple and complex metrics
4. Diversification effect	Bottom up (100+ parameters) vs. top down (2 parameters)
5. Time scale matters	Need enough years of data to work with



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Data

14 Annual Statements (1997-2010)

- 24 accident years
- 23 years of reserve runoff, up to age 10 years
- By company (3700 in total across all lines & years)

- Premium risk
 - Premium and L&LAE ratios by company and year
 - 20,000 data points for PPA
 - 4,500 for med mal occurrence
- Reserve risk
 - Incurred & paid by company, AY, age
 - 20,000 data points for PPA
 - 6,000 for med mal occurrence

Net Loss and Loss Expense Percentage		
GA A	GA B	GA C
1988	0.222	0.856
1989	0.773	0.602
1990	0.506	1.052
1991	0.393	0.899
1992	0.526	1.101
1993	0.797	0.993
1994	1.021	0.814

Company	Inherent	Rate/Exp	Rate/Inc	Rate/PA	Rate/LAE
2001	0.000	0.000	0.000	0.000	0.000
2002	0.000	0.000	0.000	0.000	0.000
2003	0.000	0.000	0.000	0.000	0.000
2004	0.000	0.000	0.000	0.000	0.000
2005	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.000	0.000	0.000	0.000
2007	0.000	0.000	0.000	0.000	0.000
2008	0.000	0.000	0.000	0.000	0.000
2009	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000



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RBC Formula: UW Risk Charges

- Factors applied to premium or reserves by LOB
 - Premium Risk Factors (PRFs)
 - Reserve Risk Factors (RRFs)
 - Selected factors are adjusted for
 - Investment income
 - Own-company experience
 - Loss sensitive contracts
 - (For PRFs) own-company expenses.
- Indicated factors: 87.5th percentile observed from all companies (after filtering) by LOB
 - Due to size effects, actual average safety margin is 90th-95th percentile
- Diversification reflected through "70% rule"



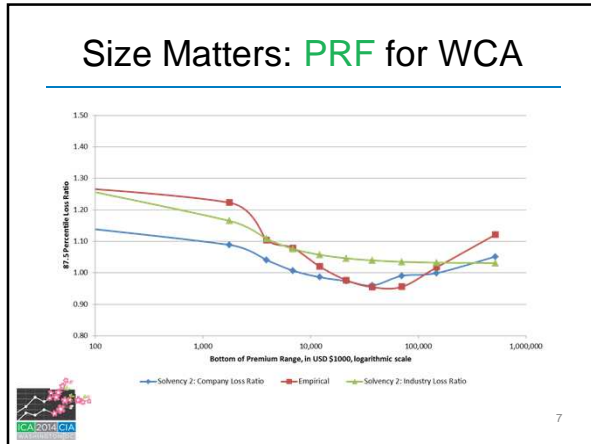
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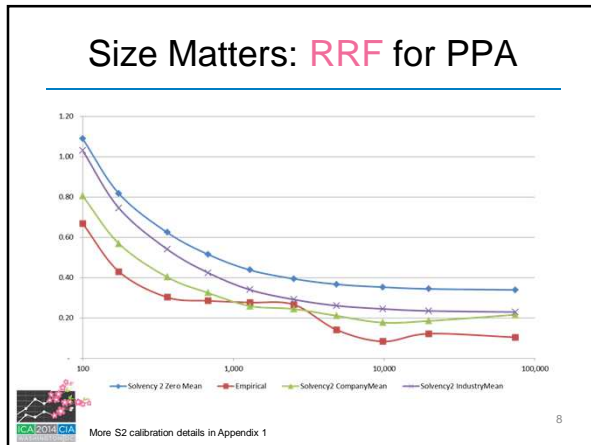
1. Size Matters

- Indicated risk charge (87.5th percentile) varies with size
- Pattern appears to depend on factors in addition to size
- Standard formulas generally choose risk charge that does not vary with size, e.g.
 - Median
 - Based on "large enough" companies



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2. Type of Company Matters

- Risk charge varies by type of company
 - Reinsurer, standard lines insurer, PL specialist, etc.
- Calibrating on data points that exclude “minor lines” removes much (but not all) of the effect
 - “Minor line” = LOB as % of total company less than some threshold (e.g., 5%)

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Type matters: Reinsurers

Exhibit 3.1: PRFs - All Reinsurers

Line of Business (LOB)	Reins vs. Non-Reinsurer Larger difference before minor line filter						
	Including Minor Lines			Excluding Minor Lines			
	(1)	(2)	(3)	(4)	(5)	(6)	
	Specialists	Non-Specialists	Difference	Specialists	Non-Specialists	Difference	
A	Homeowners/Harmowners	0.908	0.966	-0.057	0.874	0.956	-0.082
B	Priv. Passenger Auto Liability	1.079	0.982	0.097	0.998	0.973	0.025
C	Commercial Auto Liability	1.122	0.984	0.139	0.979	0.982	-0.003
D	Workers' Compensation	1.202	1.053	0.149	1.067	1.04	0.027
E	Commercial Multiperil	1.041	0.922	0.118	1.002	0.881	0.122
F1	Medical Mal - Occurrence	1.599	1.667	-0.068	N/A	1.458	N/A
F2	Medical Mal - Claims made	1.308	1.2	0.108	0.946*	1.141*	0.2051*
H	Other Liability	1.194	1.011	0.183	1.07	1.016	0.053
J	Auto Physical Damage	0.925	0.862	0.064	0.806	0.842	-0.036
N&P	Reinsurance A & C	1.331	1.621	-0.291	1.288	1.303	-0.015
O	Reinsurance B	1.329	1.652	-0.323	1.306	1.343	-0.037



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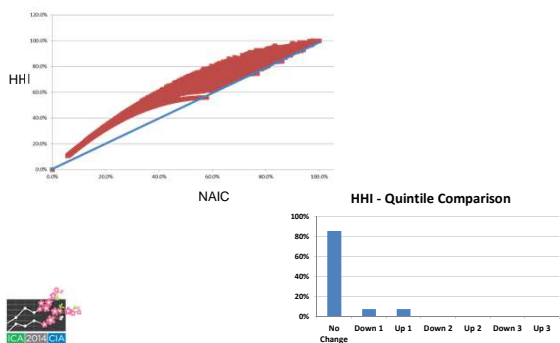
3. Diversification Metrics

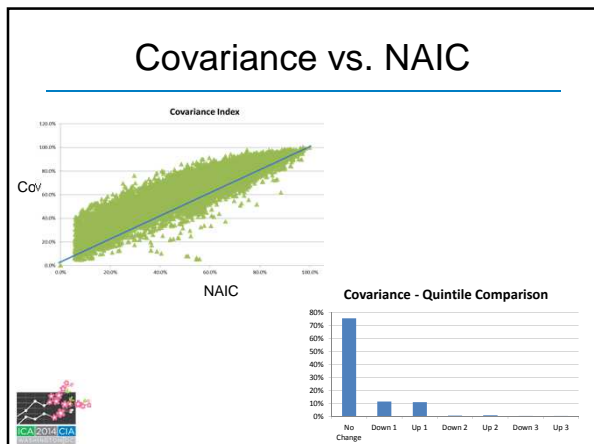
- NAIC RBC diversification measure
 - $(\text{Max LOB Premium}) / (\text{All LOB premium})$
- Alternative diversification measures
 - HHI index (sum of squares of percentages by LOB)
 - Covariance matrix
- Company diversification rankings similar, *regardless* of diversification measure



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HHI vs. NAIC





4. Diversification Effect

- Divide companies by size and diversification
 - 5 size bands
 - 6 diversification bands, incl. monoline (0 diversification)
 - Total of 30 cells

- Calculate 87.5th percentile all-LOB PRF for each cell
 - If no diversification effect, PRFs constant down columns
 - Decreasing PRF measures diversification benefit

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Diversification Effect: Actual vs. Model

Indicated -NAIC Diversification						NAIC 70% Rule					
Div Band	Premium Size Band					Div Band	Premium Size Band				
	A	B	C	D	E		A	B	C	D	E
0	45%	25%	24%	26%	35%	0	32%	32%	32%	31%	27%
1	47%	20%	26%	23%	40%	1	25%	27%	27%	32%	24%
2	42%	21%	16%	18%	15%	2	24%	24%	24%	24%	23%
3	44%	21%	20%	19%	19%	3	23%	23%	23%	24%	20%
4	35%	14%	20%	20%	18%	4	22%	22%	21%	22%	20%
5	52%	24%	15%	18%	17%	5	21%	21%	20%	21%	20%

Data: 17.8% Indicated: 21.8%

NAIC 40% Rule					
Div Band	Premium Size Band				
	A	B	C	D	E
0	32%	32%	32%	31%	27%
1	24%	26%	26%	30%	23%
2	22%	21%	21%	21%	20%
3	19%	20%	19%	20%	17%
4	17%	18%	17%	18%	16%
5	16%	16%	15%	15%	15%

Indicated: 17.9% 15

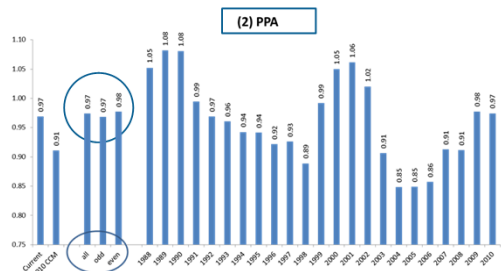
5. Time Scale Matters

- PRF and RRF by AY show UW cycle effects
- Even/Odd test over 24 AYs appears reasonably stable
 - Also tested every 4th year for stability



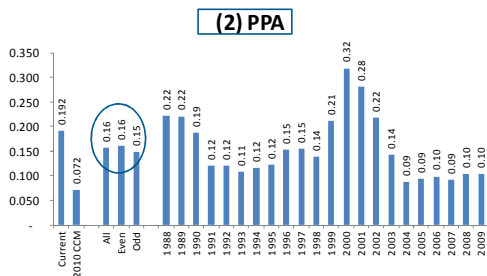
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Premium Risk Charge by AY

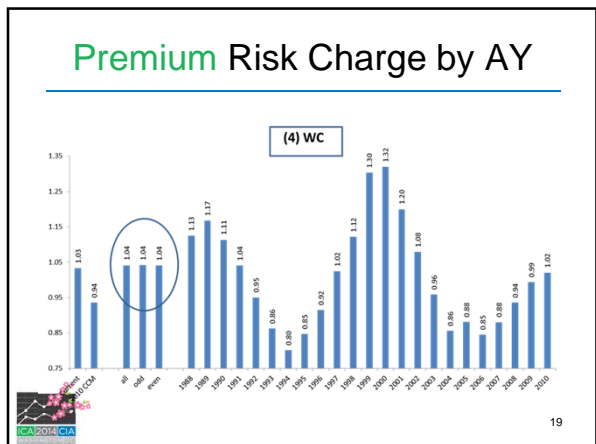


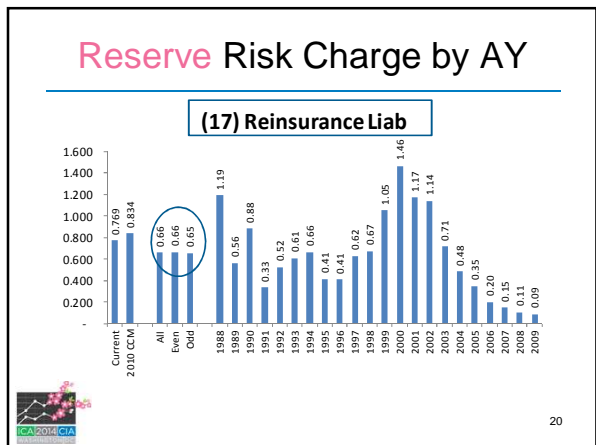
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Reserve Risk Charge by AY



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Other Findings


(Too much for discussion today; See appendices)

Consideration	Finding
6. Reinsurance-related risks	Reinsurance risk is not just counterparty solvency risk
7. Age of company	Companies with more years of experience appear to have lower risk charges
8. Arbitrary safety metric	"Consumer Welfare" metric is an alternative

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Questions?


Comments / suggestions
for the Working Party?



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Appendices

1. Solvency II calibration approach applied to US data
2. Risk charge indications by type of company
3. Diversification credit: examining the experience
4. Effect of reinsurance on risk levels
5. Effect of company age on indicated risk charge
6. Consumer value risk metric
7. Other stuff Alice moved to appendix




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Appendix 1

Solvency II and Empirical Size Calibration

Apply Solvency II approach to US Data

Solvency II approach as described in:
Calibration of the Premium and Reserve Risk Factors
in the Standard Formula of Solvency II, Report of the
Joint Working Group on Non-Life and Health NSLT
Calibration, 12 December 2011




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Appendix 1

Solvency II Loss Ratio Model

- Random loss ratios driven by compound poisson process
- Variance related to size (premium)
- Parameters vary over time
- The expected value of the random process is the expected loss ratio
- The variance of the process is a quadratic function of size and size-squared
 - Linear size-term implies variance goes to zero
 - Quadratic size-term implies variance goes to constant value
- Error function normal or lognormal
 - Normal illustrated here




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Appendix 1

Solvency II Loss Ratio Model

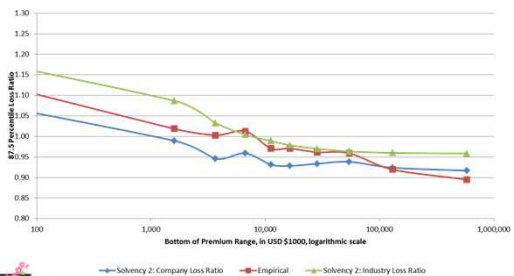
- Loss ratio and variance parameters can be industry-wide values or company specific values
 - Data sparser for company-specific parameters, but fit better
 - We consider both industry and company loss ratio parameters
 - Use only industry variability parameter
- Normal and Lognormal error functions produce similar results
 - Neither is a very good fit to small or large LOB-sizes




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Appendix 1

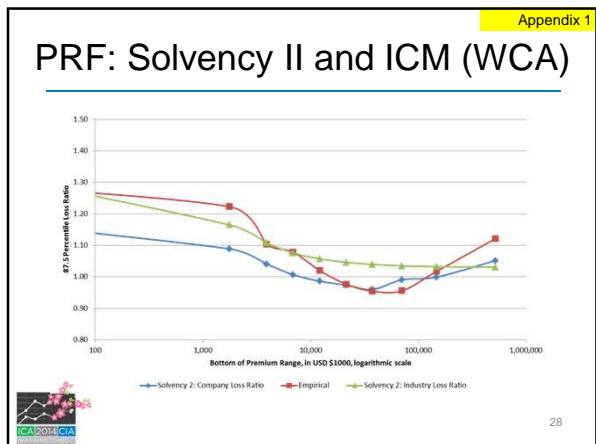
PRF: Solvency II and ICM (PPA)

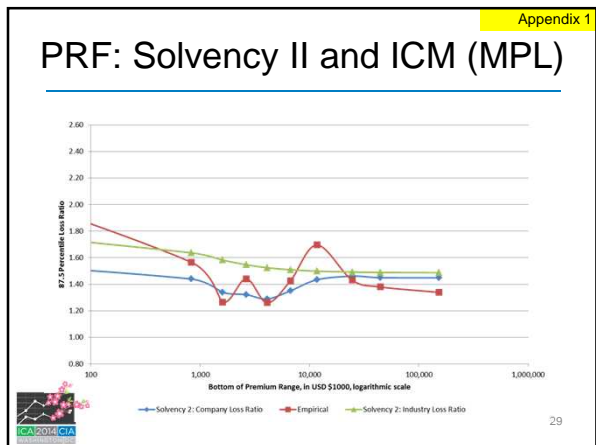


Bottom of Premium Range (USD \$1000)	Solvency 2: Company Loss Ratio	Empirical	Solvency 2: Industry Loss Ratio
100	1.05	1.10	1.15
1,000	0.98	1.02	1.08
10,000	0.95	0.98	1.02
100,000	0.93	0.95	0.98
1,000,000	0.92	0.93	0.96

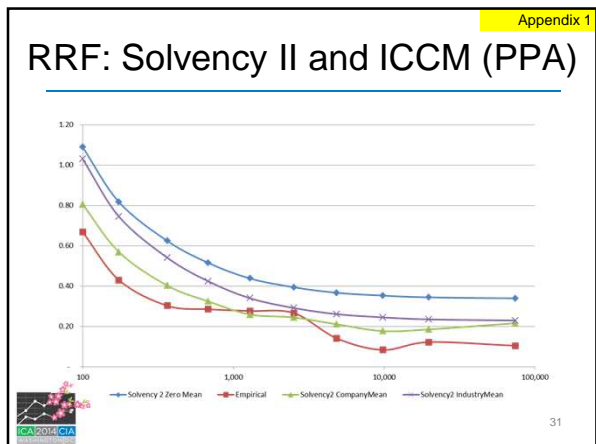


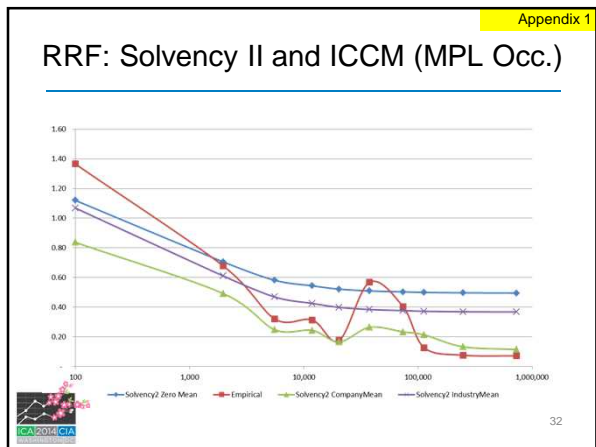
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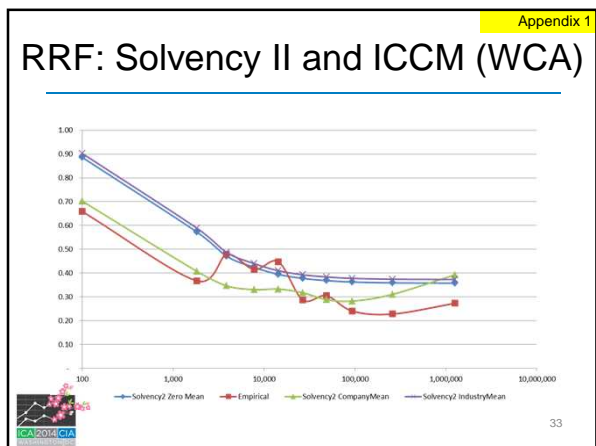




- Appendix 1
- ### Solvency II: Reserve Runoff Variability
- Same model
 - Size = initial reserve
 - Comments regarding premium apply equally to reserve runoff
 - Consider expected runoff =
 - Industry average,
 - Company specific, or
 - Zero
- ICAP 2014 CIA
- 30








Appendix 2

Risk Charge by Type of Company




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Appendix 2

Approach

- Assign each data point to a “business focus”
- We use SNL areas of business focus
 - Reinsurance, personal lines, medical professional, commercial, workers compensation....
- Note: companies write multiple LOBs outside of their “business focus”




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Appendix 2

Approach

- Use ICM baseline database to determine 87.5th percentile loss ratio (PRF)
 - By LOB
 - Separately for companies within each “business focus”
- Data considerations
 - Pools assigned business focus based on majority of number of companies in DCWP -defined pool
 - Business focus based on current mix of business; historic mix (24 years) may be different




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Appendix 2

Findings

- “Minor line” filter mitigates differences by type of company
 - PRF differences by type of company smaller after minor line filter
 - Type of company differences remain




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Appendix 2

Observations: Business Focus = Reinsurance

- We'll refer to Reinsurers as “specialists”
- Specialist PRFs are lower than non-specialist PRFs in specializing lines [Lines N&P and O];
[Next slide: [Are Col 3 & 6 <0]]
- Difference between specialists and non specialists is smaller with minor line filter than without minor line filter. [Is |Col 6| < |Col 3|?]
- For non-specializing LOBs, Specialist PRFs are not always higher or lower than non-Specialist PRFs. [Col 6 > or < 0]




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Appendix 2

Prof Reinsurers

Exhibit 3.1: PRFs - All Reinsurers

Line of Business (LOB)	Reins vs. Non-Reinsurer Larger difference before minor line filter					
	Including Minor Lines			Excluding Minor Lines		
	(1) Specialists	(2) Non-Specialists	(3) Difference	(4) Specialists	(5) Non-Specialists	(6) Difference
A Homeowners/Farmowners	0.908	0.966	0.057	0.874	0.956	-0.082
B Priv. Passenger Auto Liability	1.079	0.982	0.097	0.998	0.973	0.025
C Commercial Auto Liability	1.122	0.984	0.139	0.979	0.982	-0.003
D Workers' Compensation	1.202	1.053	0.149	1.067	1.04	0.027
E Commercial Multiperil	1.041	0.922	0.118	1.002	0.881	0.122
F1 Medical Mal - Occurrence	1.599	1.667	-0.068	N/A	1.458	N/A
F2 Medical Mal - Claims made	1.308	1.2	0.108	0.946**	1.141**	0.201**
H Other Liability	1.194	1.011	0.183	1.07	1.016	0.053
J Auto Physical Damage	0.925	0.862	0.064	0.806	0.842	-0.036
N&P Reinsurance A & C	1.331	1.621	-0.291	1.288	1.303	-0.015
O Reinsurance B	1.329	1.652	-0.323	1.306	1.343	-0.037




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Appendix 2

Observations: Business Focus = Personal Lines

- We'll refer to Personal Lines Companies as "specialists"
- Specialist PRFs are lower than non-specialist PRFs in specializing lines [Lines A & B]; [Are Col 3 & 6 <0]
- Difference between specialists and non specialists is (slightly) smaller with minor line filter than without minor line filter. [Is |Col 6| < |Col 3|?]
- For non-specializing LOBs, Specialist PRFs are lower than non-Specialist PRFs. [Col 6 > or < 0]



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Appendix 2

Personal Lines

Exhibit 3.2: PRFs - Personal Lines

Line of Business (LOB)		Including Minor Lines			Excluding Minor Lines		
		(1) Specialists	(2) Non-Specialists	(3) Difference	(4) Specialists	(5) Non-Specialists	(6) Difference
A	Homeowners/Farmowners	0.954	0.981	-0.027	0.952	0.958	-0.006
B	Priv. Passenger Auto Liability	0.949	1.045	-0.096	0.947	1.028	-0.08
C	Commercial Auto Liability	0.9	1.023	-0.122	0.904	0.998	-0.095
D	Workers' Compensation	0.965	1.085	-0.121	0.944	1.06	-0.116
E	Commercial Multiperil	0.857	0.965	-0.108	0.814	0.917	-0.104
G	Special Liability	0.931	1.014	-0.083	1.201	0.943	0.258
H	Other Liability	0.902	1.054	-0.151	0.865	1.033	-0.168
J	Auto Physical Damage	0.846	0.884	-0.038	0.844	0.839	0.005
N&P	Reinsurance A & C	1.553	1.523	0.031	1.2	1.302	-0.102

*Asterisks identify PRFs that were computed with fewer than 100 data points, and thus may be unreliable.




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Appendix 2

Observations: Business Focus = Commercial Lines

- We'll refer to Commercial Lines Companies as "specialists"
 - Commercial Lines is all lines except Personal and Reinsurance
- Specialist PRFs are not generally lower than non-specialist PRFs in specializing lines [All lines excl. A, B & O]; [Are Col 3 & 6 <0]
- Difference between specialists and non specialists is not particularly smaller with minor line filter than without minor line filter. [Is |Col 6| < |Col 3|?]
- It may be that this category is too diverse to reflect significant patterns related to specialization



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Commercial Lines Companies

Exhibit 3.3: PRFs - Commercial Lines

Line of Business (LOB)	Including Minor Lines			Excluding Minor Lines			
	Specialists	Non-Specialists	Difference	Specialists	Non-Specialists	Difference	
A	Homeowners/Farmowners	0.973	0.963	0.01	0.918	0.957	-0.039
B	Priv. Passenger Auto Liability	1.015	0.98	0.035	0.993	0.972	0.02
C	Commercial Auto Liability	1.029	0.98	0.05	0.997	0.979	0.018
D	Workers' Compensation	1.083	1.052	0.031	1.059	1.037	0.022
E	Commercial Multiperil	1.012	0.917	0.094	0.911	0.878	0.033
G	Special Liability	0.97	1.019	-0.05	0.848	0.976	-0.128
H	Other Liability	0.996	1.026	-0.03	0.974	1.039	-0.065
I	Special Property	0.843	0.834	0.008	0.804	0.82	-0.016
J	Auto Physical Damage	0.876	0.863	0.013	0.816	0.844	-0.028
K	Fidelity & Surety	0.848	0.811	0.036	0.732	0.6	0.132
L	Other	0.943	1.007	-0.065	0.897	0.956	-0.059
O	Reinsurance II	1.59	1.504	0.085	1.462	1.319	0.143
R	Products Liability	1.22	1.267	-0.048	1.134	1.277	-0.143



3. Diversification Credit Examining the Experience



Diversification Credit


- Divide companies by size (5 bands) and diversification ranking (6 bands, including one band for monoline = 0 diversification)
- Calculate 87.5th percentile PRF for all lines combined within each diversification/size cell
- If no diversification effect, PRFs constant down columns
- Decrease in PRF down a column is measure of diversification benefit



Appendix 3

All Lines Diversification: Findings

- Rather than a simple pattern we find several regions
 - Benefit for diversification increases down column for smallest sizes
 - Benefit for diversification from diversification band 0 to band 2 for larger companies
 - Little apparent benefit of diversification for larger three size bands beyond diversification band 2




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Appendix 3

Indicated Risk Charge By Size & Degree of Diversification

Div Band	Indicated -NAIC Diversification				
	Premium Size Band				
	A	B	C	D	E
0	45%	25%	24%	26%	35%
1	47%	20%	26%	22%	40%
2	42%	21%	16%	18%	15%
3	44%	21%	20%	19%	19%
4	35%	14%	20%	20%	18%
5	52%	24%	15%	18%	17%
Data			17.8%		




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Appendix 3

Diversification Data Characteristics

- Number of data points uniformly distributed, as intended
- Most premium is in “lower right corner”
- Standard deviations behaves somewhat as expected
- Loss ratios vary by size/diversification data cell
- Loss ratio, standard deviation and distribution by cell drive 87.5th percentile



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Appendix 3

Diversification Data Characteristics

Data Points by Prem Size Band					
Div Band	Premium Size Band				
	A	B	C	D	E
0	3,270	2,327	1,709	1,236	654
1	784	801	864	761	439
2	503	727	921	841	656
3	522	766	772	859	729
4	323	632	739	827	1,127
5	84	232	481	971	1,880

% Premium by Prem Size Band					
Div Band	Premium Size Band				
	A	B	C	D	E
0	0.0%	0.2%	0.4%	1.0%	4.4%
1	0.0%	0.1%	0.2%	0.6%	4.1%
2	0.0%	0.1%	0.2%	0.7%	14.2%
3	0.0%	0.1%	0.2%	0.7%	12.3%
4	0.0%	0.0%	0.2%	0.7%	23.0%
5	0.0%	0.0%	0.1%	0.9%	35.5%

Std Dev by Prem Size Band					
Div Band	Premium Size Band				
	A	B	C	D	E
0	64%	37%	35%	27%	31%
1	55%	30%	28%	25%	27%
2	38%	25%	22%	18%	22%
3	46%	25%	20%	21%	19%
4	35%	21%	19%	21%	15%
5	44%	20%	18%	18%	15%

Mean Loss Ratio by Prem Size Band					
Div Band	Premium Size Band				
	A	B	C	D	E
0	72%	64%	65%	70%	78%
1	77%	68%	69%	68%	74%
2	71%	68%	70%	72%	76%
3	82%	67%	69%	73%	75%
4	73%	64%	69%	72%	74%
5	81%	68%	69%	73%	73%

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Appendix 3

Actual vs. Model

- RBC "model" of diversification effect is 70% rule applied to premium (reserve) risk charges by line
 - How well does that "model" fit the data?
 - Can fit be improved by changing the 70% parameter to other values, e.g. 50% or 25%?

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Appendix 3

Actual vs. Model

Indicated - NAIC Diversification					
Div Band	Premium Size Band				
	A	B	C	D	E
0	45%	25%	24%	26%	35%
1	47%	20%	26%	22%	40%
2	42%	21%	16%	18%	15%
3	44%	21%	20%	19%	19%
4	35%	14%	20%	20%	18%
5	52%	24%	15%	18%	17%

NAIC 70% Rule					
Div Band	Premium Size Band				
	A	B	C	D	E
0	32%	32%	32%	31%	27%
1	25%	27%	27%	32%	24%
2	24%	24%	24%	24%	23%
3	23%	23%	23%	24%	20%
4	22%	22%	21%	22%	20%
5	21%	21%	20%	21%	20%

NAIC 40% Rule					
Div Band	Premium Size Band				
	A	B	C	D	E
0	32%	32%	32%	31%	27%
1	24%	26%	26%	30%	23%
2	22%	21%	21%	21%	20%
3	19%	20%	19%	20%	17%
4	17%	18%	17%	18%	16%
5	16%	16%	15%	15%	15%

Data			17.8%		
Indicated				21.8%	
					17.9%

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Appendix 4

Regression Analysis of Risk Factors

Significance of Reinsurance Usage




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Appendix 4

Insolvency History

1996-2010 Impairments*

- 397 impaired companies
- 3,287 unimpaired companies
- 10.8% impairment over 14 years
- 0.8% impairment rate per year
 - This count may not be complete
 - Our main objective is to review risk characteristics of insolvencies; for that purpose a representative sample is sufficient




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Appendix 4

Impaired vs. Unimpaired Companies

- Risk Characteristics
 - Premium size
 - State concentration
 - LOB concentration
 - Reinsurance usage
 - Main geographic region
- Evaluate relative “mortality” rate by risk characteristic (univariate basis only)



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Appendix 4

Insolvency by "LOB Concentration"

- Increasing impairment to the right as LOB concentration % increases
- Bubble size represents number of impaired companies (data set)
 - 202 companies in largest bubble
 - 8 companies in smallest bubble
- The range of insolvency rates is a factor of 5.0

LOB Conc %	Relative Impairment Rate
~10%	0.26
~40%	0.79
~80%	1.22

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Appendix 4

Insolvency by Reinsurance Usage

- Increasing impairment rate to the right as reinsurance usage (ceded % of gross WP) increases
- Bubble size represents number of impaired companies (data set)
 - 214 companies in largest bubble
 - 22 companies in smallest bubble
- The range of insolvency rates is a factor of 3

Reinsurance Usage	Impairment Rate
~10%	0.75
~40%	1.5
~80%	2.03

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Appendix 4

Regression Analysis Model

The two-year impairment probability for the i^{th} company, p_i , is assumed to be a logistic function of n predictive variables

$$(X_n): \text{Logit}(p_i) = B_0 + B_1 X_{1i} + B_2 X_{2i} + \dots + B_j X_{ni}$$

where, $\text{Logit}(p_i) = \ln(p_i / (1 - p_i))$.

The explanatory variables can be either continuous or categorical.

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Appendix 4

Impairment Risk Factors

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits	Wald Chi-Square	Pr > ChiSq
Intercept	1	-0.1920	0.3522	-10.6582 -5.3258	74.02	<.0001
Cedinging_j	0-10%	0.2324	0.1991	-0.6973 0.6827	2.16	0.1420
Cedinging_j	10-40%	0.9510	0.2245	0.5111 1.3909	17.35	<.0001
Cedinging_j	40-70%	0.5382	0.2125	0.1817 1.0148	7.32	0.0049
Cedinging_j	70-80%	0.7149	0.2819	0.1624 1.2674	6.43	0.0112
Cedinging_j	80-90%	0.9019	0.2761	0.3608 1.4430	10.67	0.0011
Cedinging_j	90-100%	0.0000	0.0000	0.0000 0.0000		
MC_j	1	0.8525	0.1461	0.5682 1.1389	34.05	<.0001
Flines_j	1	1.0662	0.1739	0.7212 1.4053	37.38	<.0001
Max_Cp	1	0.0150	0.0005	0.0091 0.0205	79.07	<.0001
BondHiresRelec_j	1	-1.4603	0.1480	-1.7504 -1.1701	97.31	<.0001
Inflsets_j	1	-0.1910	0.0203	-0.2307 -0.1513	88.80	<.0001
SurplusRatio_j	1	-5.4090	0.2899	-5.9770 -4.8410	348.31	<.0001
Scale	0	1.0000	0.0000	1.0000 1.0000		

Control Factors


Reins
LOBs
Reins



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Appendix 5

Years of Earned Premium Experience Effect on Risk Charge




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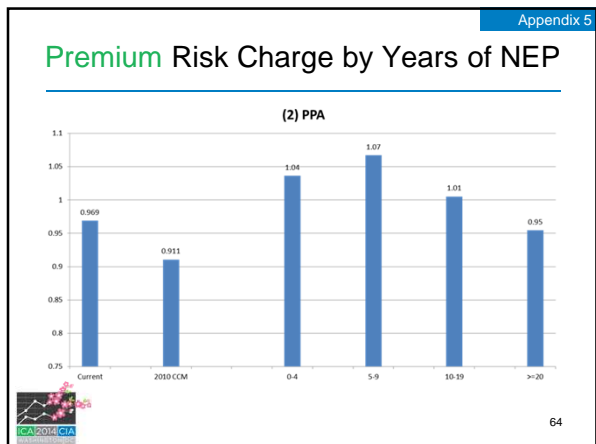
Appendix 5

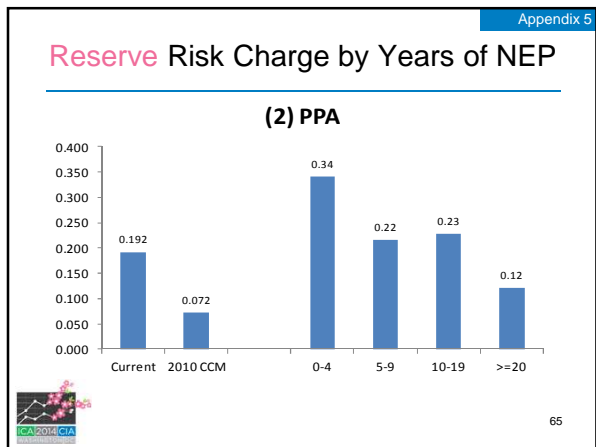
Mature Companies = Lower Risk

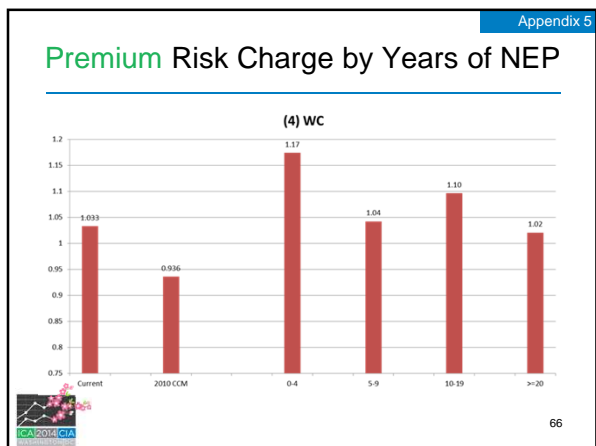
- Baseline excludes data points from companies with less than five years of non-zero net earned premium (NEP)
- Often, but not universally, indicated risk charge declines for business with longer history
- For long tail lines, the effect of “development maturity” may be confounded by the effect of “longer history”, making “older age” look less important than it is

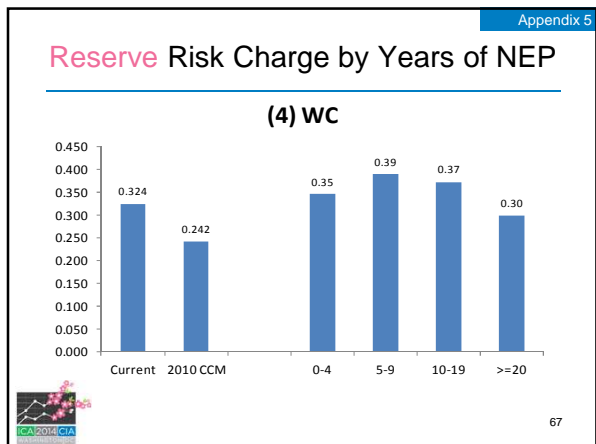


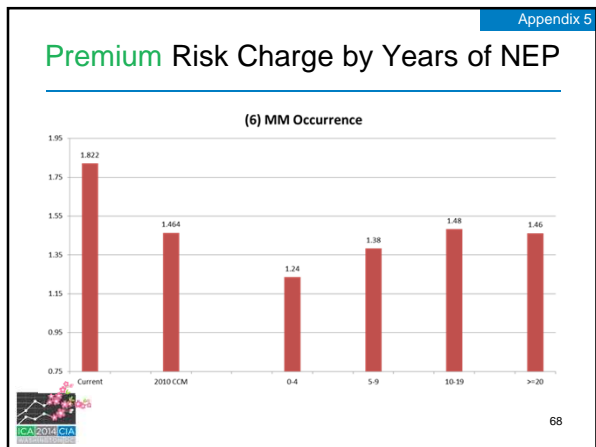
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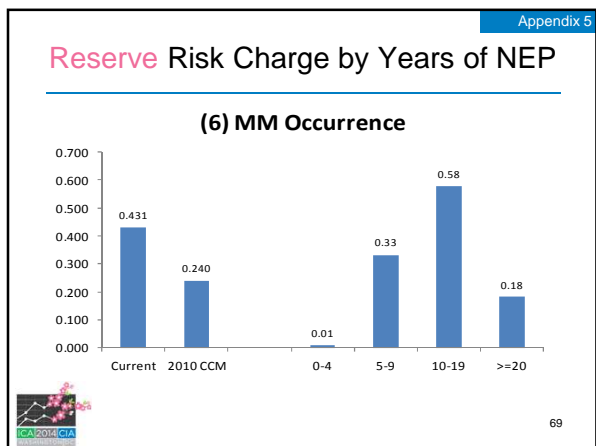













Appendix 6

Consumer Value Risk Metric




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Appendix 6

Risk Metric Alternatives

- CCM and ICM risk metric = 87th %ile over all companies all years (“current”)
- Alternatives (not tested) include
 - Higher VaR
 - Within years
 - Within companies
 - TVaR or other risk metric
 - Alternative treatments of UW cycle
 - “Consumer Value” measure




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Appendix 6

Consumer Value Parameters

Rather than “arbitrary” VaR or TvaR selections, “Consumer Value” parameters are

- Cost of Capital
- Consumer Utility Function (what is certainty equivalent of losses of various size)
- Distribution of insurer’s potential total losses



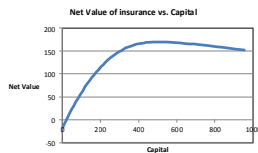
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“Consumer Value Risk Metric”

- Optimize “consumer” value considering:
 - Benefit of lower default risk from capital increase
 - Cost of higher premium from capital increase
- Optimized risk metric is VaR of loss distribution transformed to give higher probability weight to losses in the tail
- Shape of consumer value is not highly sensitive to capital near the optimum level



Consumer Benefit vs. Capital



- Consumer benefit, “net value”, varies +/-10% while required capital varies by factor of over 1.5
- Caveats
 - Parameters to assess optimization still illustrative
 - Actual parameterization will be problematic



See More At:


An Economic Basis for P/C Insurance RBC Measures (Report 5)

<http://www.casact.org/pubs/forum/13sumforum/01RBC-econ-report.pdf>



Appendix 7

DCWP: The People The Work Product



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Appendix 7


DCWP Publications To Date

Overview of Dependencies and Calibration in the RBC Formula (Report 1) www.casact.org/pubs/forum/12wforum/DCWP_Report.pdf

2011 Research – Short Term Project (Report 2) www.casact.org/pubs/forum/12wforum/RBC_URWP_Report.pdf

Solvency II Standard Formula and NAIC RBC (Report 3) <http://www.casact.org/pubs/forum/12forumpt2/RBC-DCWPRpt3.pdf>

A Review of Historical Insurance Company Impairments (Report 4) <http://www.casact.org/pubs/forum/12forumpt2/RBC-DCWPRpt4.pdf>



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Appendix 7


DCWP Publications To Date

An Economic Basis for P/C Insurance RBC Measures (Report 5) <http://www.casact.org/pubs/forum/13sumforum/01RBC-econ-report.pdf>

Premium Risk Charges – Improvements to Current Calibration Method (Report 6) <http://www.casact.org/pubs/forum/13forum/01-Report-6-RBC.pdf>

Reserve Risk Charges – Improvements to Current Calibration Method (Report 7) <http://www.casact.org/pubs/forum/14wforum/Report-7-RBC.pdf>

Differences in Premium Risk Factors by Type of Company (Report 8)
Publication pending




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Appendix 7

DCWP Reports in Preparation

- Application of Solvency II Calibration Method to RBC Premium and Risk Factors
- Regression analysis of risk factors associated with insurance company impairments
- Reserve Risk Factors – Individual Company Basis vs. NAIC RBC Basis
- Dependency and Credit for Diversification in NAIC RBC Formula
- Risk Metric – Time Horizon Analysis (extension of Report 5)
- Impact Analysis – Assessment of effect of changes in RBC Formula by type of company
- RBC Premium Risk Factor Calibration based on Combined Ratio Rather than Loss Ratio




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Appendix 7

RBC Research Working Party Members (2013)

Emmanuel Theodore Bardis	Allan Kaufman (Chair) Alex Krutov* Terry T. Kuruville	Ashley Arlene Reller David A. Rosenzweig*
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Pablo Castets	Zhe Robin Li	Sweetser
Christian Citarella	Lily (Manjuan) Liang	Anna Marie Wetterhus
Joseph F. Cofield	Thomas Toong-Chiang	Jennifer X. Wu
Jose Couret	Loy	Jianwei Xie
Brian A. Fannin	Glenn G. Meyers	Linda Zhang
Sholom Feldblum	Daniel Murphy	Christina Tieyan Zhou
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Dean Guo	G. Chris Nyce	Karen Sonnet
Shira L. Jacobson	Jeffrey J. Pfluger	David Core
Shiwen Jiang	Yi Pu	




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* Liaisons to CAS or Academy

Appendix 7

RBC Research Working Party 'Retired' Members (2011-2012)

Karen H. Adams Damon Chom Orla Donnelly Chris Dougherty Nicole Eliot Kendra Felisky	Timothy Gault Jed Nathaniel Isaman James Kahn Alex Krutov Eduardo P. Marchena	Mark McCluskey Daniel Murphy James P. McNichols David L. Ruhm Ji Yao
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Appendix 7

Work Stream Leaders

Work Stream	Leader	Team
Overview Reports 1 and 2	Rept-1 A. Kaufman Rept-2 D. Murphy	Committee members as listed on those reports
3. Solvency II Formula and RBC	Joe Cofield	Christina Zhou
4. Insolvency Risk Factors-Univariate	Ed Marchena	
5. Risk Metric	Bob Butsic	Sholom Feldblum, Glen Meyers
6. Premium Risk Factors	Jennifer Wu, Dennis Franciskovich	Karen Adams, Franco LePera, Daniel Murphy, Tim Sweetser
7. Reserve Risk Factors	Jennifer Wu	Karen Adams, Dennis Franciskovich, Franco LePera, Daniel Murphy, Tim Sweetser




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Appendix 7

Work Stream Leaders

Work Stream	Leader	Team
8. Risk Charge by Type of Company	Ashley Reller	
9. Solvency II Calibration	Jeff Pflugger, Tim Sweetser	Glen Meyers
10. Insolvency risk Factors-Regression	Jose Couret	
11. Rsv Risk Charge - Individual Co Model vs. RBC	Manolis Bardis	Christian Citarella, Glen Meyers, Linda Zhang, Damon Chom
12. Dependency	Apundeeep Lamba	Shiwen Jiang, Glen Meyers, Dan Murphy, Damon Chom
13. Impact Analysis	Ron Wilkinson	Ji Yao, Damon Chom, Dean Guo
14. Combined Ratio	Douglas Nation	



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